SCIENCE

VOL. 88 FRIDAY, NOVEMBER 4, 1938 No. 2288

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal
Lancaster, Pa. Garrison, N. Y.

Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary in the Smithsonian Institution Building, Washington, D. C.

CLINICAL INVESTIGATION[1]

By Dr. GEORGE R. MINOT

PROFESSOR OF MEDICINE, HARVARD UNIVERSITY, DIRECTOR, THORNDIKE MEMORIAL LABORATORY, AND VISITING PHYSICIAN, BOSTON CITY HOSPITAL

WE are here to-day to celebrate the opening of the Squibb Institute for Medical Research, which stands as a fitting tribute to Edward Robinson Squibb, the founder of this distinguished pharmaceutical organization. Dr. Squibb was an eminent physician and chemist and his name has become synonymous with certain ideals in medicine and pharmacy. The scientist's love for truth, so marked in him, and the painstaking and conscientious care of every detail of his activities led him to never neglect research and general scientific work, which he recognized as essential. Dr. Squibb's services to the army and navy, especially during the Civil War, were most significant, for he supplied them with highly dependable medical supplies and particularly anesthetics. His master formula was honor, integrity and trustworthiness. His work was such that no contemporary had to consider writing such a book as Christopher Merrett wrote in 1669 with the title, "A Short View of the Frauds and Abuses committed by Apothecaries; as well in Relation to Patients, as Physicians: and the only Remedy thereof by Physicians making their own Medicines." Dr. Squibb's published investigative studies extended from 1855 to 1900, in which year he died at the age of eighty-one. The studies concern especially the production and preparation of therapeutic substances which the physician prescribes and which must in final analysis be tested on human beings for their exact action and value—a form of clinical investigation.

It is a physician who undertakes clinical investigation, and I plan to consider a few general aspects concerning this subject especially as referable to the physician and patient.

[1] Presented at the dedication exercises of the Squibb Institute for Medical Research, New Brunswick, N. J., on October 11, 1938.

Doctors deal with human problems, and to solve them an active creative imagination and scientific curiosity are necessary tools. Every patient who consults a doctor presents a problem for investigation before the best advice can be offered. There is nowhere that a patient stands so good a chance of being benefited as in a clinic where his disease is arousing scientific curiosity. A studious inquiry of sick people is what every good practitioner makes daily. At the bedside he must constantly sharpen his powers of observation and judgment and recognize that his education is never ended but must be continued by his own strenuous mental effort. Any doctor should appreciate the spirit and understand the principles of research and develop an investigative habit of mind. His curiosity to learn must never wane, for if it does he soon will become inefficient. Since medicine deals so essentially with human problems the physician must constantly strive to broaden his outlook on life. This may be done by cultivating interests that often would be considered far removed from the practice of medicine, such as some aspects of natural history or art. These various attributes of a physician must be applied at the bedside in the elucidation of the phenomena of disease. There is no sharp line of demarcation between the practicing physician and the physician who makes it one of his duties to conduct clinical investigation. Indeed the best sort of properly trained clinical investigator must be an able clinician, one who understands human beings and can act wisely for all aspects of a given individual. His training in investigative principles must be sound, and he should have an ardent desire to seek for knowledge by scientific methods. In other words, he must wish to carry the torch forward so that the oncoming generation of physicians will find it nearer the ultimate goal.

Clinical investigation may be pursued in institutions designed only for that purpose or in any hospital. It may also be undertaken wherever the physician has his headquarters if he trains himself to keep in mind the study of problems. The establishment of appropriate space and opportunities for clinical investigation in large hospitals where the study of patients under controlled conditions can be undertaken seems especially wise. This permits investigators to be surrounded with a wealth of clinical material for study from which ideas can originate and allows the hospital to be a progressive modern institution and the patients to receive the very best treatment. It is of great advantage if the clinical investigator is in close contact with men working in a wide variety of scientific fields and especially in those disciplines closely related to clinical medicine, such as pharmacology, bacteriology, chemistry and biology, as you have here in this institute. Mingling of such men offers opportunity for the free exchange of thought which can lead to beneficial results. Indeed this arrangement allows the ideas originating from the needs of the patient to be readily carried for elucidation to some laboratory of fundamental science, and knowledge obtained there to be applied in the clinic. For the cure and prevention of disease and the relief of pain the final test is on man himself, so that a clinical investigative unit need be a part of, or associated with, an institute for medical research. The director of this institute, Dr. Harrop, certainly appreciates this, if for no other reason than because of his well-recognized accomplishments in the fields of experimental medicine and clinical investigation, which make advances hand in hand. I am delighted to learn that clinical facilities with a small ward for the observation of patients in connection with various problems being studied by the research staff are being planned.

Clinical investigation does not necessarily require great laboratory set-ups. The sick individual is the center of the picture, so that wards with patients are the salient feature of the clinical investigative unit. Clinical investigations frequently are suggested from individual patients' problems, and these may concern matters removed some distance from the patient himself. Indeed, clinical investigation may necessitate pursuit at a distance from the investigator's headquarters or institute because the solution of problems may be found, for example, in the physical, biological or social aspects of a patient's community or home. The technical apparatus required for intelligent observations and for the proper care of the patient is but a means to an end and is a relatively insignificant, though often to the casual observer the most impressive, feature of a clinical investigative unit. The most important and significant possession, besides the sick people, is the recorded data collected with a view to obtaining a definite pattern and often ascertained by simple procedures, frequently entirely by the use of the intellect. It is from the trustworthy records of natural phenomena and of the actions of organisms under controlled experimental conditions that concepts concerning disease are formulated leading to the alleviation of man's ailments and to knowledge of intrinsic scientific interest. The plodding worker often obtains a long record and masses of data which are sometimes thought to be an indication of good work. That is often far from the case, because the data recorded may have been obtained without critical understanding. Quantity does not supplant quality. The individual with an aggressive inquiring mind can often by skilfully planned questions and observations in relatively small quantity elicit more significant information than is found in some voluminous records. Thus the foundation of research work lies in the quality of the minds of the investigators and the freedom and tranquility permitted for the

use of their abilities. Free choice of problems and free choice to follow leads disclosed must be the privilege of the experienced investigator.

Although any physician may conduct clinical investigation and share his knowledge with his colleagues, the term clinical investigator is usually applied to a man who devotes a considerable amount of time to the study of clinical problems in organized clinical laboratories. Many men who essentially never observe a patient work in numerous fields of science studying problems pertaining to the clinic, but such individuals are not clinical investigators.

A trained clinical investigator may approach problems, broadly speaking, in two different ways. In the first instance an experienced clinician seeks tools through which to solve problems that originate in his mind at the bedside; for example, the man who appreciates that to supply the deficiency of the blood-clotting mechanism in hemophilia chemical procedures should be utilized in an effort to discover something that might permanently alleviate the patient if given by injection each day. The second method of approach is also for a man with clinical training, but one who has acquired the use of tools, to take them to the bedside to apply them to problems suggested by the tools; for example, a man trained in chemistry and especially in the chemicophysical aspects of the clotting of blood, who seeks a patient to elucidate the mechanism of blood coagulation. The former is more truly the clinical investigator, and it is by the intellectual rather than by the technical method that he approaches problems, concerning sick individuals. This does not imply that it is unwise for investigations of fundamental importance to proceed from purely morphological, chemical or physiological motivations without reference to the immediate needs of the clinic, for it is by the study of fundamental problems that most significant advances are made. Both types of clinical investigators have their place in the development of useful knowledge, but if aggregations of individuals, chosen only because they are acquainted with special techniques, form the personnel of a clinical investigative unit the practical needs of clinical medicine are apt to be forgotten.

It is certainly an incorrect conception of research that it makes a man heartless, unsympathetic or indifferent to human suffering. Indeed, many able clinicians who have spent much time in investigation are unusually keen in their ability to appreciate and to treat wisely the anxieties and emotional disturbances of patients. In reality the clinical investigator is apt to be successful somewhat in proportion to his appreciation of the sick man as an individual. He is usually one who has some inborn quality which fits him for an earnest search for knowledge and who by proper training in a suitable environment develops his inquiring abilities. He must have the power to see straight, which is a rare gift. To see no more and no less than is actually before one, to see with one's reason as well as with one's perceptions—that is to be an observer and to read the book of nature aright. To note the resemblances of things one to another may be an essential point in acquiring information. Factors often need study one at a time, yet it must not be forgotten that synthesis is essential in the formulation of final knowledge. The investigator must ponder on topics where emotions blend with cold reason and where the answer is dictated by the emotions, though it is largely formed by reason. Emotion is the driving force that arouses inquisitiveness, sustains interest and keeps the investigator at work through drudgery. Reason is the critical control that guides and checks progress. It is developed by long training in the scientific method. Emotion and reason are always mixed; one can only do one's best to use each for its serviceable purpose and avoid the usual mistake of allowing emotions to dominate one's judgment.

The problem of whether a man is to undertake clinical investigative work does not depend on his precise occupation but lies in the man himself. He who undertakes clinical investigation, however, must learn to recognize clinical facts, realize that intuition often guides and that the patient's health must never be jeopardized. He must establish a detailed diagnosis without pothering over unessential details and proceed to action for every aspect of the patient and his case. Anything studied faithfully develops the mind. Thus, besides what is gained by investigative work itself, this type of work has great educational value. Every physician must be trained to look at problems from more than one angle and be unwilling to confine himself to standardized procedures. Throughout life the physician must keep abreast of the times and, by making frequent contacts with those especially studying medical problems, he will constantly imbibe knowledge. An understanding of the principles of scientific investigation aids him to judge critically, to appreciate the nature and significance of proper controls, and to evaluate the significance of the many communications published on medical topics.

Before a problem is intensively studied it is essential to become acquainted with previously acquired knowledge on the subject. Although subservience to the past makes stagnation, development of it is true progress. Science may render that which went before obsolete, but it builds upon the past, constantly advancing new knowledge from the standpoint of the already known. Thus the investigator must consult authorities in large part by going to the library. Consulting colleagues is extremely helpful but does not alone take the place of reading what has been written on a subject. Conversation alone as the only basis for obtaining information

can lead to confusion between "authority and the oracle," which is perilous to scientific work. A library is not merely a hall of books but a hall of records of human experience and thought, where one may learn the path along which man has toiled and may discover guiding and liberating influences for the future.

Clinical investigation takes a variety of forms. The aim should be to undertake fundamental problems and to appreciate that progress in the clinic often owes its origin to the fields of pure science. The studies are often of a collective nature, as in the evaluation of clinical data, the evaluation of new procedures or in the correlations of chemical and pathologic information. Proper statistical methods must be employed and standard deviations and probable errors calculated. The descriptive discipline of nosography—the painting of accurate pictures of disease—is a useful guide to keep experimental procedures from going astray. This type of work may depend on the good fortune of observing several cases and not on planned investigation. There is need for more accurate work of this sort especially concerning initial symptoms and the natural history of long-lasting chronic conditions. Controlled observations of human pathologic physiology is the nature of many of the studies of the clinical investigator. The question of the origin or cause of disease is of unusual importance to study. Therapeutics, which is linked with pharmacology, is essentially an experimental science and will always have experimentation on man for its chief basis. The action of drugs always needs evaluation. The object, however, is to study the human body and not drugs *per se,* and one method of doing so systematically is by means of its reaction to chemical and physical agents.

The control of experimental conditions in human beings is crude as compared to the utmost rigidity in the control of the worker in pure science, so that data of observations may be only qualitative or but crudely quantitative. One of the many variable factors is dependent on the fact that the human being has a soul and highly organized nervous system. His emotional reactions, worries, jealousies and the like and his reactions to one or more persons can not only lead to illness but affect the functions of organs. The medical-social, psychological, economic and allied aspects of individuals can be investigated with profit. The field is a difficult one for reliable scientific study, because it involves all the complexities of human life. Even so, a considerable fraction of the successful care and treatment of patients and the prevention of much illness is to be identified with the proper consideration of their medical-social problems. A list of the studies a clinician may pursue is of little value. It is more significant to realize that a prepared mind, well-planned scientific observations and the taking of infinite pains will lead to success, and that important original contributions often are made which require only simple technique and clinical wisdom.

The clinical investigator in his search for truth is not to be thought of as a lone worker or as a man sharply separated from other types of doctors. A close relationship with practitioners, specialists, pure laboratory investigators of many types is mutually beneficial. The men in this institute, like investigators elsewhere, naturally realize that assistance may be obtained from a wide variety of divergent sources and that science is not bounded by the walls of any one institution. There are no sharp lines of demarcation between one medical interest and another or between medicine and a variety of disciplines. Cross-fertilization at the border lines of knowledge can serve to develop new information. The advancement of learning can not be made in water-tight compartments. Modern developments have permitted team work in scientific fields to be much more general and prolific where before isolated efforts were the rule. Cooperative investigations between physicians, scientists and all types of scholars trained in different ways as well as between men in different institutions can enhance knowledge concerning the treatment and prevention of disease and the happiness and progress of a people. Such cooperation when spontaneous is fruitful, but when compelled it may be sterile.

More fundamental than the actual discoveries being made to-day is the preservation of the right to engage in research. If all governments, races and individuals would hold the same high ethical view-point of life that Dr. Squibb did, there would be no murmurings of intolerance to intellectual freedom. Security and happiness have profound beneficial effects on the character of intellectual work. As time passes by we must always be alert to adapt ourselves to changes and realize that to understand the present we must look both towards the past and towards the future.

BIOLOGY AND INDUSTRY IN COOPERATION[1]

By Professor **AUGUST KROGH**

HEAD OF THE DEPARTMENT OF ANIMAL PHYSIOLOGY IN THE UNIVERSITY OF COPENHAGEN

IT is a great pleasure as well as a great honor to assist at the inauguration of these laboratories, which represent a very important step forward in the ever closer cooperation between biological science and biotechnical industry.

[1] Presented at the dedication exercises of the Squibb Institute for Medical Research, New Brunswick, N. J., on October 11, 1938.

That industrial development is deeply influenced by scientific discoveries has long been recognized in the case of physics and chemistry, and I need only mention such names as Faraday, Oersted and Hertz and the electrical industry to make it clear to you how enormous the influence has been.

The influence of biological sciences on what I would call biotechnical industries is a later development, but not less profound, and the relations between industry and biological science is, as all good and durable relations should be, by no means one-sided, but mutual, science deriving extremely valuable help and stimuli from the industries. I propose to discuss briefly such mutual relationships as illustrated by conditions in Europe and I shall go a little more into the relationships in Denmark to which I can claim some first-hand knowledge.

The preparation of biological products for human use and consumption is as old as civilization itself. The fermentation of sugars was utilized before the dawn of history, products of the silk industry in China reached the western world by trade centuries before any European had ever visited the Far East. It is a cause for wonder how many potent drugs were discovered by a process of practically unconscious trial and error through many generations in remote antiquity.

Until about a century ago the preparation of biological products, including drugs, took place largely as home industries and on a small scale, while the manufacturing processes were the results of tradition created by practical experience. Mishaps were very common, but their effects local and as a rule not very serious. There were as a matter of course large variations in the fermentations underlying the productions of wine and beer. Bacteria would occasionally make their appearance and spoil the products completely, and diseases would attack the plants which supplied the raw materials. Large variations occurred in the potency of drugs, but were rarely discovered because of the lack of precision with which their effects could be determined.

The difficulties became apparent and their seriousness appreciated when attempts were made to work on a large scale, and science was called in to help solve these difficulties. The work of Louis Pasteur furnishes one of the oldest and certainly the most brilliant example of what science could do to help biotechnical industries like the production of wine, beer and vinegar and, the most spectacular of all, his saving of the French silk industry in the years 1865–71. In Denmark the scientific work in the interest of agriculture dates back to about the same time and has been vigorously prosecuted ever since.

Assistance rendered by science to industry was necessarily the first step to make industry interested in the development of science and the mutual help has naturally taken many different forms.

A close and fruitful cooperation between science and pharmaceutical industry is illustrated in the history of the firm of Merck at Darmstadt. The apothecary Heinrich Emanuel Merck started a production of purified drugs, especially alkaloids, on a comparatively large scale in 1827. He was the owner of the Angel Pharmacy, which had at that time been in the possession of the family during five generations and for over 150 years. He was a very good chemist, a close friend of Liebig, and had himself worked out methods for the isolation and purification of several alkaloids. It is a very remarkable fact, speaking highly for his scientific spirit, that he did not keep his methods secret, but published his results in sufficient detail to allow others to benefit by them.

The firm was carried on as a family undertaking. At the present time it has, under the direction of the great-grandsons of Heinrich Emanuel, grown into a huge concern and is doing a large amount of scientific work in the interest of the firm. They have very large laboratories for the synthesis of substances. They have pharmacological, chemotherapeutic and bacteriological departments for the exhaustive study of the action of their preparations on the animal and human body, for the control of sterility, and so on. An important new branch is concerned with the application of micro-organisms for the production of new substances by their controlled activity.

H. E. Merck a hundred years ago kept up a considerable correspondence with scientists in Germany and elsewhere, both giving and receiving suggestions and advice, and out of this has grown the "scientific department" of the present firm, whose chief business it is to keep in touch with practice and with independent science. They receive and examine all kinds of hints and suggestions with regard to the activity of the firm, trying to meet the wishes of individual workers, and they also take care of all inquiries, general or special, and supply information not only from knowledge directly available in the minds and memories of scientists in the employ of the firm, but in many cases they also undertake a search of the literature and even go to the length of actual experimentation to satisfy inquirers. The value to independent workers of thus having at their disposal the accumulated experience and knowledge of experts can scarcely be overestimated.

I would like to emphasize the services rendered to science by the firms supplying pure chemicals and pure drugs. It does not seriously detract from these services and it shows the difficulty of the task that in spite of all care the purity obtained is not always suffi-

cient. There is a recent example studied by Güntelberg in Denmark, where it was found that a content of 0.05 per cent. bromine present in analytic chloride preparations from a number of firms had disastrous results in electrometric pH measurements, and a few years ago the presence of minute traces of silver in sodium chloride made Ringer solutions definitely poisonous for fish hearts.

The firms are, as a rule, ready to render assistance when new substances are desired for experimental purposes, and I would like to mention a point where demands are being made which, if they can be fulfilled, will prove of very great value to experimental biochemistry. I refer to the production of organic substances like amino acids and lipoids containing deuterium instead of hydrogen in certain selected positions in the molecule. If such substances, which are, as we call it, "labeled" by the content of deuterium, but chemically identical with those containing ordinary hydrogen, can be made available they will be extremely useful in the study of intermediate metabolism.

It is of course impossible to mention here all the firms which by the work in their own laboratories have rendered services of great value to biological science, and I am fully aware that my selection is largely arbitrary and determined by my personal interests. I can not refrain, however, from referring to the brilliant work by Stoll, Rothlin and their collaborators in the firm of Sandoz. Unlike most other firms, they have cultivated a restricted field and made fundamental contributions to the chemistry and pharmacology of the alkaloids from Secale and the glycosides from Digitalis, Scilla and Strophanthus.

I would also mention the work done in the laboratories of Hoffman la Roche on the synthesis of vitamins and the work done in the laboratories of the firms Ciba, Organon and especially Schering, on the isolation, determination and synthetic preparation of sexual hormones as well as their contributions towards the clearing up of the terribly complicated problems relating to the pituitary hormones. To the work on sex hormones also the laboratories of Danish firms (Leo) have made notable contributions, and I want to emphasize the point that in the academic study both of vitamins and of hormones the laboratories of commercial firms have played a very conspicuous part and greatly accelerated progress.

So far as I have been able to ascertain the laboratories mentioned are all rather intimately connected with the firms supporting them, and each works ultimately in the interests of the firm. Certain leaders of industry, however, have been broad-minded and deep-sighted enough to create and support laboratories for fundamental research having for their avowed object the progress of science and the furtherance of industry generally without regard to the interests of their own firm. The example best known to me is the Carlsberg Laboratory, founded by the proprietor of the Carlsberg breweries, J. C. Jacobsen, in Copenhagen and almost at once handed over, together with the necessary capital, to an independent trust, the "Carlsberg Foundation," the members of which were selected by and among the Danish Royal Society of Science and Letters.

The Carlsberg Laboratory began work as early as 1876. The main object was stated in the words, "To provide a scientific basis, as complete as possible for the operations of malting, brewing and fermentation." At the same time the leaders were requested to maintain a high scientific standard by other studies and investigations, and it was expressly laid down that "No result of theoretical or practical importance may be kept secret." The work was to be supervised by a board consisting of three members of the Carlsberg Foundation representing natural sciences and two others, of which it is customary that one represent the Carlsberg breweries. The money allotted to the Carlsberg Laboratory was at first about $10,000 yearly and is now about $50,000.

The first leaders of the Carlsberg Laboratory were Johan Kjeldahl and Emil Chr. Hansen. Kjeldahl made his name a household word in chemical, biological and biotechnical laboratories all the world over by his method of nitrogen determination, and he made also very important studies of carbohydrate splitting enzymes. Hansen is chiefly known by his studies of yeasts leading to the adoption of pure strains of yeast derived from one single cell in the brewing and other industries. The successor of Kjeldahl was S. P. L. Sörensen, whose work on pH definition and determination is too well known to need any reference.

When Jacobsen died in 1887 the Carlsberg breweries were handed over to the Carlsberg Foundation and their income became available for the support of science, letters and art in Denmark, including the maintenance of the Carlsberg Laboratory. The benefits to science have been enormous and on the whole the arrangement has worked well, but I have grave doubts regarding the general wisdom of selecting by and from a body of scientists the leaders of a very large industrial undertaking.

The history of the Wellcome trust in England is in important respects very similar to that of the Carlsberg Foundation. The Wellcome Research Laboratories were established in the beginning of this century by the proprietor of the Burroughs Wellcome firm of manufacturing chemists to undertake medical research of a fundamental nature, and very important work was done under the leadership of Dale on the ergot alkaloids and on anaphylaxis. In 1924 the Wellcome

Foundation was established to take over the business and to keep up the different Wellcome laboratories and museums, and on the death of Sir Henry Wellcome in 1936 the whole estate was placed in trust for the benefit of medical science not only in England but in the world. I understand, however, that in this case the firm is carried on independently of the trust, which only disposes of the income.

This arrangement is somewhat similar in principle to another Danish experiment in cooperation between science and industry. Shortly after the discovery of insulin we undertook under a license from the University of Toronto the manufacture of insulin, primarily for the Scandinavian market, and arrangements were made to make this undertaking a public trust, the proceeds of which should be devoted to the furtherance of physiology and clinical endocrinology.

Under the leadership of Dr. Hagedorn the Nordisk Insulin Laboratory has grown into a fairly large concern, maintaining its own hospital for the study of endocrine disorders and fulfilling, I believe, an important function in keeping insulin prices in Europe at a comparatively low level. The surplus is handed over to the Scandinavian Insulin Foundation, composed of clinicians and physiologists from Denmark, Finland, Norway and Sweden, who distribute grants in aid of research. I think this a fair way of letting the exploitation of a scientific discovery help to further scientific research, but of course everything depends upon finding the right man to make such an undertaking a success.

With the inauguration of the Squibb Institute for Medical Research which we are dedicating to-day the firm of E. R. Squibb and Sons enters upon what constitutes in my opinion the highest level of cooperation between science and industry so far attained. In this case also a great deal depends upon finding the right man and I wish to express my confidence in my old friend, Dr. Harrop, who will be the leading spirit on the scientific side.

In the firm conviction that great benefit will accrue both to the firm, to the industry generally and to our beloved science I wish to express the gratitude of biology and to offer my heartfelt congratulations.

OBITUARY

RAYMOND H. TORREY

RAYMOND H. TORREY, one of the nation's leaders in the field of outdoor recreation and conservation, died at his home in Queens, Long Island, on July 15, 1938, upon his fifty-eighth birthday. Mr. Torrey was born in Georgetown, Massachusetts, and was a son of Captain Grafton F. Torrey, of Deer Island, Maine. He embarked upon a newspaper career at the age of sixteen and worked in Springfield, Massachusetts, until 1903, at which time he went to New York City to join the City News Association. At one time, he was night city editor of the *New York American* and the *New York Tribune*.

From the very beginning, Mr. Torrey showed a native interest in the out-of-doors and through the years gathered a great deal of information concerning history, geology and botany. At the time of his death, he was president of the New York Torrey Botanical Club and had become nationally known as an authority on lichens, having published a number of papers upon the subject, especially in the New York Torrey Botanical Club bulletins.

He was the organizer of the New York and New Jersey Trail Conference, and secretary of that conference for many years. He was also secretary of the Association for the Protection of the Adirondacks, secretary of the American Scenic and Historic Preservation Society and a member of the board of managers of the Appalachian Trail Conference, which organization directed the building and maintenance of the Appalachian Trail, a mountain footpath leading from Maine to Georgia. Mr. Torrey was also a former secretary of the New York State Council of Parks and former field secretary of the National Conference on State Parks. He was a member of the board of managers of the New York Botanical Garden, a member also of the American Museum of Natural History, the American Geographical Society, the American Association for the Advancement of Science, the Appalachian Mountain Club, the Green Mountain, Adirondack Mountain, Fresh Air and Tramp and Trail Clubs.

As field secretary of the National Conference on State Parks, Mr. Torrey traveled throughout America and reported upon the progress of parks in this country. His report entitled, "State Parks and Recreational Uses of State Forests," published by the conference in 1926, was one of the first comprehensive surveys of our park systems. As the principal author of "The New York Walk Book," together with Dr. Robert L. Dickinson and Mr. Frank Place, Mr. Torrey set before the people of metropolitan New York an outstanding compendium of recreational opportunities. The book has been reprinted several times and has been the means of informing countless citizens regarding various objectives along many trails.

Mr. Torrey's column, "The Long Brown Path," was published for many years in *The New York Post*. This newspaper column served to inform interested readers of opportunities to study botany, geology and zoology out-of-doors, and also helped them to realize

the need for conservation wherever wilderness conditions remain. Mr. Torrey was a pioneer in locating and marking hiking trails in the eastern states. He also was responsible for placing large numbers of historical signs along the highways in the State of New York.

His friendly and kindly personality will be missed by many of his friends throughout the country. He was a man who believed firmly in his own convictions and who, in his last years, fought vigorously to prevent various agencies from despoiling our Eastern mountains with roads and other encroachments. He delighted in standing upon high places and looking toward far horizons and, better than this, he encouraged others to follow in his footsteps.

WILLIAM H. CARR

RECENT DEATHS AND MEMORIALS

DR. ADDINELL HEWSON, professor emeritus of anatomy in the graduate school of medicine of the University of Pennsylvania and in the dental school of Temple University, died on October 27. He was eighty-three years old.

SIR ROBERT LUDWIG MOND, British financier and industrialist, died on October 15 at the age of seventy-one years. Besides engaging in research in pure and applied chemistry, Sir Robert directed a series of explorations in Thebes, Palestine and Brittany.

DR. R. G. AITKEN writes that in his obituary notice of W. W. Campbell in the issue of SCIENCE for July 8, 1938, the date of his birth is given incorrectly. It should be April 11, 1862.

THE Cornell Society of Engineers has presented to the university a portrait of the late Rolla C. Carpenter, formerly professor of experimental engineering. It is painted by Professor Olaf M. Brauner and will be one of the group of portraits of distinguished members of the department to be hung in the renovated Sibley Dome. Professor Carpenter joined the faculty as associate professor of experimental engineering in 1890.

SCIENTIFIC EVENTS

ACCOMMODATIONS FOR THE RICHMOND MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

RECENT correspondence indicates that there may be fears respecting accommodations for the approaching meeting of the association in Richmond, Va., which are not fully justified.

There are two aspects of the question of accommodations for meetings of the association, that of convenient rooms for the scientific sessions and that of guest rooms for individuals. A careful survey last January showed that in Richmond there are 79 rooms (24 having a seating capacity of more than 200 each) available for scientific sessions, the total seating capacity being 17,800. These 79 rooms are located in four rather compact groups, and hence it has been possible to schedule all the sessions of closely related sciences near one another. The greatest distance in walking time between any two rooms in any of the four groups is four minutes, and the greatest distance between any two groups is one and one-half miles. Each of the 79 rooms can readily be equipped for the use of a stereopticon. Moreover, the space available for the use of microscopes and for the showing of biological specimens is unusually commodious and satisfactory. Consequently, the accommodations for the scientific sessions are adequate and conveniently located. In fact, few cities can provide so many good meeting rooms in so small an area.

When it comes to guest rooms for visiting scientists the conditions are not so favorable, but they are far from being seriously unfavorable. In Richmond there are seven first-class and five second-class hotels, in addition to excellent rooms, each with a bath, in the dormitory of the Medical School, and there are other possibilities. It should be noted at once that the hotels in Richmond are doing everything within their power to provide the association and its affiliated societies with adequate accommodations. All the rooms for scientific sessions and for committee meetings are provided without charge. The rates for guest rooms in no case have been increased. Of course, the Richmond hotels, like those in all other cities, have rooms at various levels of prices depending on their size and furnishings. Naturally not every person can secure the minimum rate in the hotel he chooses. The Jefferson Hotel, which was built before the days of severe economies in space, has a considerable number of unusually large combination bedrooms and sitting rooms which, of course, are not available at minimum rates, but in which two or more friends can obtain excellent accommodations at a very moderate cost to each.

All the Richmond hotels are cooperating fully in providing the maximum capacity at the lowest possible cost to guests. In addition, there is a local committee on housing, of which the chairman is Mr. Foley F. Smith, A.B.C. Laboratory, Richmond, Va., to which every person having difficulties in securing accommodations should write, stating his requirements.

HOTELS IN RICHMOND

Jefferson. With bath: Single, $3 to $3.50; double, $5 to $8. Without bath: Single, $2 to $4.

John Marshall. With bath: Single, $3 to $5; double, $5 to $8.

Murphy. With bath: Double, $3.50 to $6. Without bath: Single, $2.50 to $3; double, $3.

Murphy Annex. Without bath: Single, $1.50; double, $2.50.

Richmond. With bath: Single, $2.50 to $3.50; double, $5 to $7. Without bath: Single, $1.50 to $2; double, $3.50.

Rueger. With bath: Single, $2.25 and up; double, $3.75 to $5. Without bath: Single, $1.75 and up; double, $3 to $3.50.

Capitol. With bath; Single, $2 to $2.50; double, $2.50 to $3.50. Without bath: Single, $1.25 to $1.50; double, $2.00 to $2.50.

William Byrd. With bath: Single, $2.50 to $4.50; double, $4 to $7. Without bath: Single, $2 to $2.50; double, $3 to $4.

Travelers. With bath: Single, $1.50 to $2; double, $2.50 to $3.

Sharlee. With bath: Double, $1.50 and up. Without bath: Single, $1; double, $1.50 and up.

Gilbert. With bath: Single, $1.50 and up. Without bath: Single, $1 and up.

Connell & Miller. With connecting bath: Single, $1.25 and up; double, $2.

Walford (Y.W.C.A.). With running water: Single, $1 to $1.50; double, $2.50. With bath: Double, $2.50.

In addition to the hotels there are excellent tourist homes, most of which are new houses, in which rooms may be secured through Mr. Smith's committee at from $1.00 to $2.00 per day. These tourist homes are on the principal boulevards within twenty minutes by frequent bus service from all meeting places of sections and affiliated societies.

As has been stated, the rooms available at Richmond for the scientific sessions are abundant and within easy reach of one another. Although the hotel accommodations may fall short of all requirements, it is not likely that any one having a little patience will suffer serious inconvenience. The housing committee will have an information desk at the Headquarters in the Mosque and in all principal hotels with lists of all available accommodations and will assist those who have not made arrangements for rooms before arriving in Richmond.

F. R. MOULTON,
Permanent Secretary

PRIVATE LANDS IN THE LASSEN VOLCANIC NATIONAL PARK

PROHIBITION against hunting on private lands embraced within the limits of Lassen Volcanic National Park has been upheld in an opinion by Frederick L. Kirgis, acting solicitor of the U. S. Department of the Interior, and approved by the Assistant Secretary of the Interior, Oscar L. Chapman.

Secretary of the Interior Harold L. Ickes had asked for an opinion to clear up questions raised by an opinion of the attorney general of California as to the effect of National Park Service regulations in respect to privately owned lands in the park.

The state attorney general had held that the state game and fish wardens had jurisdiction over the privately owned lands in the park area when a question came up regarding measures taken by the federal park rangers to prevent hunting and other threatened disregard of the strict Park Service regulations.

Exclusive jurisdiction over the entire park area, whether privately owned or land to which the Federal Government has title, now will be assumed by the United States Commissioner for the park, and the Park Service authorities and rangers.

In support of the opinion, there was cited the Act of 1916 creating Lassen Volcanic National Park which had dedicated the entire area within the described boundaries, together with the California act ceding jurisdiction to the Federal Government. The acting solicitor said regarding the description of the area in the California act:

> The description did not exclude isolated tracts held in private ownership. The words of the California act ceding jurisdiction over the territory within the tract of land set aside and dedicated for park purposes by the United States as Lassen Volcanic National Park, constitute simply a description of the territory to which the act refers, not a restriction of the jurisdiction of the United States within the territory.

Calling attention to a later act of the Congress in 1928, by which the United States assumed sole and exclusive jurisdiction over the park, the opinion continued:

> The effect of both acts read together is that the United States has sole and exclusive jurisdiction over all the park, including privately owned lands, but such privately owned lands within the park are not dedicated to the use of the public. They can be enjoyed by the private owners and the general public has no right to encroach thereon. But the lands are entirely under the jurisdiction of the United States, except for the matters reserved by California in the act of cession. The owners of the lands must obey United States laws. California laws, except those relating to process serving, taxation and voting, are absolutely inoperative within the park.

The opinion quoted a provision of the original act of 1916 creating the park to the effect that no lands within the park boundaries held in private, municipal or state ownership should be affected by the provisions of the act. But the opinion held that this provision merely negatived the conclusion, which otherwise might be drawn, that private lands, as well as public lands,

were dedicated to public purposes. Attention was called to the fact that this provision was not contained in the Act of 1928.

The opinion relied also on decisions of the United States Supreme Court, which "has consistently held that a cession by a state to the United States of exclusive jurisdiction over a tract of land put the tract beyond the field of operation of all state laws except as to matters specifically reserved."

A SECOND SUPPLEMENT TO THE UNITED STATES PHARMACOPOEIA

AT the recent meeting of the United States Pharmacopoeia Board of Trustees authority was given for the publication of the second United States Pharmacopoeia XI supplement. It is hoped that this can be issued on January 1, 1939.

Preparation has been under way for months, and subcommittee chairmen will be in a position in the near future to submit reports on a number of revised texts. The subcommittee on scope is also considering the admission of a number of additional important new drugs.

The members of the committee are fully familiar with the outstanding advantages of the interim revision and supplement features of the Pharmacopoeial program. This gives the opportunity to issue new standards after they have been subjected to extensive checking in many laboratories.

The Pharmacopoeia Board or Committee of Revision are responsible only for the preparation of the official standards. Whether or not the Pharmacopoeia and its supplements are purchased by retail pharmacists is, in some states, entirely optional. In other states where the state law requires the possession of these books, it is a matter for the responsible state officials to enforce.

Finances are reported to be in excellent condition, and the Board of Trustees has been able to meet the revision expenses of the decade, to increase greatly the research and conference programs, and still to hold its basic reserves intact.

In preparing the second supplement, every step will be taken to insure the carrying out of the requirements of the convention for the preparation of an official text. It is expected that the revised or new monographs will be submitted in the form of proof to members of the committee of revision and given wide publicity. Following their publication, a public hearing will be granted at which members of the executive committee responsible for revised texts will be in attendance. Following the public hearing a conference with the officials of the Food and Drug Administration and the Public Health Service will be held, after which the members of the committee of revision will be given an opportunity to see and vote upon the finally approved text. When the supplement has been issued, ample time will be given before it becomes official.

AWARD OF THE WILLIAM H. NICHOLS MEDAL OF THE NEW YORK SECTION OF THE AMERICAN CHEMICAL SOCIETY

THE William H. Nichols Medal of the New York Section of the American Chemical Society has been awarded for 1939 to Dr. Joel Henry Hildebrand, professor of chemistry in the University of California.

Professor Hildebrand has pursued investigations in every field of general, physical and analytical chemistry, including such diverse questions as the vapor pressure of metal amalgams and the use of helium in preventing caisson disease, the "bends" of tunnel and caisson workers and of deep-sea divers. He was cited by the jury specifically for his study of the fundamental thermodynamic and kinetic properties of liquid and solid solutions, a field in which he is preeminent. The statement made by the jury reads:

> Professor Hildebrand is internationally respected for his contributions over many years concerning the experimental properties and theoretical aspects of substances when in the liquid or molten state. This work includes the study of mixtures of such common solvents as water, alcohol, carbon tetrachloride, chloroform and the petroleum solvents with iodine, sulfur, naphthalene, anthracene and a hundred other solids; mixtures of the solid metals with the one common liquid metal, mercury, and mixtures of solid and molten salts, like ordinary table salt, saltpeter, silver chloride, etc., with each other.
>
> He has succeeded in classifying these solutions, correlating their behavior, finding their peculiarities and deriving theoretical and mathematical relations concerning them so that their properties are known or may be predicted in a way previously impossible.
>
> In recent years, Professor Hildebrand has devoted more and more attention to the exceedingly abstruse but nevertheless fundamental theoretical problem of the intermolecular forces in liquids and liquid mixtures. If the scientist knew the exact nature of the electrical, gravitational and chemical forces exerted by each ultimate particle of matter—the molecule—on its neighboring molecules, he would be in a position to declare positively how any pure liquid or any mixture would behave.
>
> If molecules were small, hard balls, with only gravitational forces at work, their distribution in a solution would be as simple as that of a mixture of black and white marbles shaken together and poured into a vessel. But molecules are composed of positive electrically charged atomic nuclei and negative electrons, with empty space, penetrated only by these electrical forces, accounting for a large part of their volume. The forces acting between adjacent particles vary from the intense electrical attraction and repulsion of charge ions to the much smaller forces between symmetrical molecules whose electric charges are all neutralized within the structure of the

particle. Professor Hildebrand's studies in this field have led to many valuable publications in scientific journals in recent years. He is a master of the problems of solubility and solution in general.

Professor Hildebrand will receive the medal at a dinner of the New York Section on March 10, at which time he will speak on "The Solubility of Non-Electrolytes."

SCIENTIFIC NOTES AND NEWS

SIR WILLIAM BRAGG, director of the Royal Institution of Great Britain and president of the Royal Society, has been appointed to give the first Pilgrim Trust lecture at the April meeting of the National Academy of Sciences. As has already been announced, Dr. Irving Langmuir, of the Research Laboratories of the General Electric Company, will give the corresponding lecture in London on December 28. The Pilgrim Trust, established in England by Edward S. Harkness, provides funds for the exchange of lecturers on alternate years between the National Academy of Sciences and the Royal Society.

A NEURO-PSYCHIATRIC clinic building for the State Hospital for Mental Diseases at Providence, R. I., has been named for Dr. Adolf Meyer, Henry Phipps professor of psychiatry at the Johns Hopkins University School of Medicine. To mark the occasion a testimonial dinner was tendered to Dr. Meyer at the University Club, which was attended by a distinguished group of psychiatrists and neurologists. Dr. Meyer was characterized as "a wise, scientific leader of psychiatry, who has piloted the bark of this developing branch of medicine through its years of growth . . . avoiding the many pitfalls of new cults . . . always searching for scientific truth."

THE *Journal* of the American Medical Association reports that the Richmond Academy of Medicine gave on September 27 an informal testimonial dinner in honor of Dr. Stuart McGuire, emeritus professor of surgery at the Medical College of Virginia, in appreciation of his interest in and devotion to the academy. A portrait was presented to the academy on behalf of a group of donors by Dr. Roshier W. Miller. Dr. John M. T. Finney, emeritus professor of surgery at the School of Medicine of the Johns Hopkins University, was the principal speaker.

THE University of California Press announces the appearance of the volume prepared in honor of Dr. Alfred Louis Kroeber, who was for thirty-five years a member of the department of anthropology in the university. It contains thirty-six essays, on a variety of anthropological subjects, from writers in this country and from abroad, contributed "in appreciation of the scholar and in affection for the man." There is also a chapter of personal reminiscences and professional appreciation, and a list of Professor Kroeber's published writings to the present year.

AT the annual dinner on October 19 of the Congress of Anesthetists, meeting in New York City, silver plaques were awarded, in recognition of their work in "making Bellevue Hospital a world center in the research and development of anesthesia," to Dr. S. S. Goldwater, commissioner of hospitals; to Dr. Arthur M. Wright, professor of surgery, New York University; to Dr. E. A. Rovenstine, professor and director of anesthesia, New York University, and to William F. Jacobs, superintendent of Bellevue Hospital. A silver plaque was presented also to Dr. John S. Lundy, of the Mayo Clinic, Rochester, Minn., founder and editor of *Anesthesia Abstracts*. Loving cups were presented to Dr. Paul M. Wood, of Columbia University, for work in anesthesia and to Dr. Juan White-Morquecho, of the University of Mexico, for his work in the development of anesthesia in Mexico.

PRESENTATION of the gold medal of the Royal Aeronautical Society of Great Britain was made by Sir Neville Henderson, the British ambassador to Germany, to Dr. Hugo Eckener at a dinner given in Berlin on October 12 by Field-Marshal Göring for the German and foreign delegates to the annual Congress of the Lilienthal Society for Aeronautical Research. The British ambassador stated that it was the first time that the gold medal of the Royal Aeronautical Society had been awarded outside the British Empire.

DEAN JULIAN PARK, of the University of Buffalo, has sailed for France to receive the degree of doctor *honoris causa* from the University of Dijon. He will also represent Buffalo at the meeting in commemoration of the discovery of radium and x-rays to be held at the Sorbonne on November 23.

THE National Association of Science Writers has elected Leonard Engle, Science Service, Washington, D. C., and Wesley Fuller, Cambridge, Mass., to active membership. J. G. Crowther, London, has been elected to associate membership.

THE University of St. Andrews, at the annual autumn graduation ceremony, conferred the honorary degree of LL.D. on Sir Gilbert Thomas Morgan, director of chemical research in the National Physical Laboratory, Teddington.

IN recognition of his "distinguished contributions to science," the University of Halle-Wittenberg has

conferred the honorary degree of doctor of natural sciences upon Professor E. C. Stakman, head of the section of plant pathology at University Farm, University of Minnesota. Representing the University of Halle-Wittenberg in the presentation ceremonies which took place at a luncheon at University Farm recently, was P. von Stolzmann, acting consul-general for Germany, with headquarters at Chicago.

DR. ALBERT C. SNELL, of the School of Medicine of the University of Rochester, was named president-elect of the American Academy of Ophthalmology and Otolaryngology at the recent Washington meeting. He will succeed Dr. George M. Coates, of Philadelphia. Three vice-presidents were elected: Drs. William W. Pearson, Des Moines; William J. Mellinger, Santa Barbara, and Charles A. Bahn, New Orleans.

THE Academy of Physical Medicine, meeting in Washington, D. C., elected on October 26 the following officers: *President,* Harold D. Corbusier, of Plainfield, N. J.; *First Vice-president,* Dr. Fred H. Albee, New York, and *Secretary-Treasurer,* Dr. Herman A. Osgood, Boston.

FRANK MALCOLM FARMER, vice-president of the Electrical Testing Laboratories, New York, has been reelected chairman of the research procedure committee of the Engineering Foundation for 1938–39. George E. Beggs, professor of civil engineering at Princeton University, was elected vice-chairman. J. H. R. Arms will continue as secretary and Otis E. Hovey as director.

WALTER H. PARKER, professor of mining in the School of Mines and Metallurgy of the University of Minnesota, has been elected a member of the British Institution of Mining and Metallurgy.

THE title emeritus has been conferred by the University of Missouri on Dr. C. W. Greene, since 1900 professor of physiology and pharmacology.

DR. HARRY B. VAN DYKE, head of the pharmacological division of the Squibb Institute for Medical Research, has been appointed honorary professor of physiology in the College of Arts and Sciences of Rutgers University. He will serve also as research consultant in the Bureau of Biological Research.

DR. HARLEY J. VAN CLEAVE, professor of zoology in the University of Illinois, has been appointed acting head of the department. Dr. Herman B. Chase, until recently associated with the Roscoe B. Jackson Memorial Laboratory at Bar Harbor, Me., has become an instructor in zoology.

ASSOCIATE PROFESSOR P. GERALD KRUGER is acting head of the department of physics of the University of Illinois for the first semester. He takes the place of Professor F. W. Loomis, who has leave of absence, which he is spending in Europe.

DR. ANDREW VAN HOOK, of the department of chemical engineering at Lafayette College, has become assistant professor of chemical engineering at the University of Idaho.

DR. ROBERT T. HANCE, professor of zoology in the University of Pittsburgh, has leave of absence for the current academic year. He has accepted an invitation to spend the year as guest professor of biology in the Graduate School of Duquesne University in Pittsburgh.

DR. IRENE LEVIS, formerly in charge of the micro-analytical laboratory of the University of Frankfort, Germany, has been placed in charge of a micro-analytical laboratory to be established at the Case School of Applied Science. She will also give a course in micro-analysis to graduate students.

DR. MARY JUHN, research associate in the Whitman Biological Laboratories of the University of Chicago, has been appointed research associate professor in the poultry department of the University of Maryland.

EMMA F. SIRRINE, associate botanist of the Division of Seed Investigations of the U. S. Department of Agriculture, has retired after serving for thirty-three years.

DR. CHARLES W. REES, formerly associate zoologist, has been promoted to the post of zoologist in charge of the project investigations of Protozoan parasites of domestic animals, in the Zoological Division of the Bureau of Animal Industry, of the U. S. Department of Agriculture, at Beltsville, Md.

DR. LEE E. YEAGER, recently of the Division of Forest Insects of the Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture, has been appointed forester at the Illinois Natural History Survey at Urbana.

DR. C. E. ZOBELL, of the Scripps Institution of Oceanography, has been given a post-graduate fellowship at the University of Wisconsin, where he will be visiting professor in the department of limnological microbiology. Dr. D. L. Fox has been awarded a Rockefeller Foundation research fellowship. He will work at the School of Biochemistry of the University of Cambridge, England. Both have been granted sabbatical leave for a year. On the basis of work conducted at the institution, Dr. E. H. Myers, of Compton Junior College, has been awarded a Guggenheim fellowship. The fellowship accepted by Dr. ZoBell provides a stipend for a visiting professor during the year, together with the salary of a research assistant. The fellowship awarded to Dr. Fox provides a stipend, re-

search fees and travel expenses to enable him to continue his work on the carotenoid pigments of animals. Dr. Myers is working on foraminifera at the Marine Biological Laboratory, Plymouth, England.

THE British Medical Research Council has appointed Sir Henry Bashford, chief medical officer of the General Post Office, and Sir Kenneth Lee, chairman of Tootal Broadhurst Lee Company, to fill vacancies in the membership of the Industrial Health Research Board.

DR. AUGUST KROGH, professor of animal physiology at the University of Copenhagen, has been appointed lecturer for 1939 of the Cooper Foundation of Swarthmore College. He will give the lectures on the "Comparative Physiology of Respiratory Mechanisms" on March 16 and 23 and on April 6, 13 and 20.

DR. CHARLES H. BEST, professor of physiology at the University of Toronto, addressed a joint meeting of the Institute of Medicine of Chicago and the Chicago Society of Internal Medicine on October 28. He spoke on "Heparin and Thrombosis."

THE second W. E. Dixon Memorial Lecture of the Royal Society of Medicine was delivered by Sir Frederick Banting at a meeting of the Section of Therapeutics and Pharmacology on October 11. The subject of his lecture was "The Immunity Aspect of the Tumor Problem."

SIR JAMES JEANS delivered on October 8 the Lorimer Lecture of the Astronomical Society of Edinburgh. His address was entitled "The Depths of Space."

THE Institute of Medicine of Chicago announces that its fifteenth Pasteur Lecture will be given in conjunction with the Cancer Research Institute of the Chicago Woman's Club at a public meeting to be held on Tuesday evening, November 22, at eight fifteen o'clock in the auditorium of the museum of Science and Industry. Dr. Ludvig Hektoen, director of the John McCormick Institute for Infectious Diseases, Chicago, and of the National Advisory Cancer Council, Washington, D. C., will speak on "Progress in the Knowledge and Control of Cancer." A reception in honor of Dr. and Mrs. Hektoen will follow the lecture and, through the courtesy of the Museum of Science and Industry, the medical exhibits will be open.

THE new science building of Bryn Mawr College, which houses the departments of geology and chemistry, was formally opened on October 22. The principal address was made by Dr. Norman L. Bowen, professor of petrology at the University of Chicago. Other speakers were Dr. Florence L. Bascom, professor emeritus of geology at Bryn Mawr College, and Dr. Louis F. Fieser, of the department of chemistry of Harvard University, who formerly was a professor at the college. President Marion Edwards Park presided at the dedication.

DISCUSSION

GOVERNMENTAL SUPPORT OF RESEARCH IN FRANCE

THE following abstract translated from an article in "Réalités Françaises" for May, 1938, on the gradual development of the organization and financing of research in France is of interest at the present time when increased government support has been urged in this country.

ARTHUR J. DEMPSTER
UNIVERSITY OF CHICAGO

IN the past, scientific research in France received very little official support and the situation became more and more critical as the successful prosecution of scientific investigations required greater and greater expenditures for equipment. While, for example, Pasteur's apparatus could be purchased for very little, the "cyclotron" constructed for Frédéric Joliot involved an expenditure of 2,000,000 francs.

The "Caisse des Recherches Scientifique," which was created after the war, with a budget of 2 million francs, proved inadequate to support publications and the purchase of apparatus.

A new effort was made in 1924. As member of the chamber of deputies, Emil Borel, the well-known mathematician, proposed that the proceeds from a special tax should be devoted to the support of scientific laboratories. It was realized, however, that in addition to providing apparatus, it was just as important to recruit investigators and create positions where they could work free of material cares.

Up till the last few years, scientific research was centered in the universities; this, though excellent, did not make full use of the intellectual resources of the country. For the best results, it was essential to organize laboratories where instruction should not play the predominant role.

As early as 1921, Edmond de Rothschild, impressed by the important part played by scientific technique during the war, had created a foundation of 10,000,000 francs designed to provide fellowships for young investigators in subjects related to industry and national defence. The chemist, André Job, persuaded him to devote the proceeds of this endowment rather to the support of fellows in pure science, in order to com-

plete the existing "service fellowships" in the universities, which alone were available at that time, and which did not leave a student free for scientific work. The new fellowships thus created made possible among many others the early investigations of Frédéric Joliot. Intrigued by Claude Bernard's dictum that the mechanism of life might be elucidated by the study of physical-chemical phenomena, Edmond de Rothschild went further and created an enlarged endowment of 50,000,000 francs for an institute where physicists, chemists and biologists, working together, might attack this problem. Four scientists, Jean Perrin, Pierre Gérard, André Job and André Meyer, formed the permanent committee of this institute. Enlarging the original plan, a regular research organization was proposed. Four grades corresponding to university positions were planned: Boursiers (fellows), chargés de recherches, maîtres de recherches and directeurs de recherches, which would permit a man to devote himself to scientific research without giving part of his time to instruction.

The "Conseil Superieur de la Recherche"

To select the personnel and direct the expenditure, it was decided on the suggestion of Jean Perrin to form a committee of eminent scientists representing all the main branches of science, who would be willing to devote themselves to these tasks without remuneration. The proposed annual budget required by this scheme was estimated at 40,000,000 francs, of which 20,000,000 would be devoted to paying the salaries of the workers and 20,000,000 to defraying the cost of equipment. In June, 1930, Edouard Herriot, convinced by Perrin of the importance of such an organization for the national defense, asked for an appropriation from the chamber of 20,000,000 francs. An annual appropriation of 5,000,000 francs was granted and the "Caisse Nationale des Sciences" was set up. In 1931, research fellows were appointed and a committee was set up which was divided into subcommittees of ten to twelve members for each of the main branches of science. In 1933, the "Conseil Superieur de la Recherche" finally came into being.

The various sections during the first year appointed more than 200 investigators, and the 5,000,000 francs were found quite insufficient. Its appropriation was then increased to 7,500,000 francs, with the understanding that one sixth of this sum should be devoted to the humanities. In 1935, the laws in connection with the devaluation of the franc resulted in a reduction of the budget by 25 per cent. and abolished the special tax devised by Emil Borel. However, the period of difficulty was followed in 1936 by the appointment of Irène Curie-Joliot to the newly created office of undersecretary for scientific research in the government of Léon Blum. For the first time in the world, the claims of science as an essential national activity could have direct access to a government. After a few months, Irène Curie-Joliot was succeeded by J. Perrin, and the annual budget was increased from 11,500,000 to 26,500,000 francs. In 1937, thanks to the support of the minister of national education, Jean Zay, the budget was increased to 32,500,000 francs. To insure a stable organization and at the same time avoid every tendency to excessive bureaucracy, scientific directors have replaced civil service officials wherever possible.

Among the projects undertaken by the organization may be listed: the observatory for astrophysics at Forcalquier; the national chemical institute now being built at Ivry, the laboratory for atomic transformations which is a development of the laboratory of Joliot at the Collège de France, the laboratory for low temperature research at Bellevue, and in quite a different field, an "Institut des Textes." It also arranged the science exhibits at the International Exposition of 1937.

To be sure, the present annual budget of approximately 32,500,000 francs does not enlist in the service of science more than a small part of the native talent; however, the rapid increase in the budget in recent years marks a fundamental change of attitude. In France, the old belief has vanished that a true scientist lives in poverty and does marvels with makeshift equipment.

CYTOARCHITECTURE OF THE GORILLA BRAIN

The late Alfred W. Campbell (1868–1937) made one of the first, and certainly the most adequate, comparative study of cytoarchitecture of the anthropoid cortex. His well-known book, "Histological Studies on the Localisation of Cerebral Function" (1905), was based upon brains of the chimpanzee and the orang which had been supplied to him by Sherrington and Grünbaum. He had not had opportunity at this time to take up the gorilla, and since it is generally believed that the cytoarchitecture of the gorilla brain has never been studied, it seems worth while to direct attention to a little-known paper on the subject published by Campbell in 1916 after he returned to Australia. In it, incidentally he modified his earlier views on the olfactory fields. The reference is as follows:

> Alfred W. Campbell. "Histological Studies on the Localisation of Cerebral Function. The Brain of the Gorilla." *Reports from the Pathological Laboratory of the Lunacy Department, New South Wales Government*, 3: 20–35, 1916.

A copy of this report has just been sent to the writer of this note by the inspector-general of mental hospitals at Sydney, and I shall be glad to make it available through photographic reproduction to any student

of cytoarchitecture. The entire hemisphere was analyzed, and the paper is illustrated with five excellent plates. Campbell's first paragraph reads as follows:

In my work on the localisation of cerebral function, published in the year 1905, it formed part of my task to compare the cortex cerebri of homo with that of two members of the anthropoid ape family, namely, the chimpanzee (*anthropopithecus troglodytes*) and the orang-outang (*simia satyrus*). Through the kindness of Professor C. S. Sherrington, of Liverpool University, I have since been provided with the right cerebral hemisphere of a gorilla (*anthropopithecus gorilla**), which I have examined on lines similar to those followed in the original investigation, and as such specimens are difficult to obtain, and I believe this is the first to be submitted to such examination, I am prompted to offer the following report and ask that it be taken as an addendum to what I have already written.

* The animal was young, almost a baby, accordingly the myelinisation of the cortical nerve fibres was incomplete and imperfectly developed nerve cells (neuroblasts), especially in the deeper parts, were abundant. But, although the specimen differed in this way from those of the other apes examined, the determination of the various areas in which we are interested was not interfered with.

Dr. T. C. Ruch, whose forthcoming bibliography of all primate literature is being made ready for press, informs me that Campbell's study of the gorilla brain is the only complete survey in the literature. An account of Campbell's life will be found in the *Archives of Neurology and Psychiatry,* 40: 566–568, 1938.

J. F. FULTON

LABORATORY OF PHYSIOLOGY,
YALE UNIVERSITY SCHOOL OF MEDICINE

OCCURRENCE OF THE ORIENTAL RAT FLEA IN THE INTERIOR OF THE UNITED STATES

THE oriental rat flea, *Xenopsylla cheopis* (Rothschild), which is the chief transmitter of bubonic plague to man, was first reported from the interior of the United States by Roudabush and Becker.[1] They took many specimens of this flea during the year 1934 from rats shot on the dumping grounds of the city of Ames, Iowa. Next it was reported from the Middle West by Owen,[2] who found a dairy barn at the University of Minnesota Farm, St. Paul, heavily infested. The present writers now report the occurrence of this flea from two additional mid-western states, Illinois and Ohio.

Among the fleas in the collection of the Illinois State Natural History Survey were found eleven females and six males of *Xenopsylla cheopis,* which were taken by M. D. Farrar at Urbana, Illinois, on December 1, 1937, in elevator refuse. The Ohio record is based upon three females and three males sent in for identification from Youngstown, Ohio. They were taken in an office on August 10, 1938, by E. A. Berglund, and were reported to be biting men and causing considerable discomfort.

Opinion has held that this tropical rat flea can not flourish in temperate climates. Its presence for years in large numbers in the warmer port cities of the United States without being recorded from the interior of our country would appear to have justified such a conclusion. However, being now known from four of our central states, Iowa, Minnesota, Illinois and Ohio, a revision of such an opinion appears to be necessary. There is a possibility that a more resistant race of this flea has been developed in some of our northern ports, such as New York and Boston, and from there has spread to the Central States.

H. E. EWING

BUREAU OF ENTOMOLOGY AND
PLANT QUARANTINE,
U. S. DEPARTMENT OF AGRICULTURE

IRVING FOX

IOWA STATE COLLEGE

[1] R. L. Roudabush and E. R. Becker, SCIENCE, 80: 97, 1934.

[2] W. B. Owen, *Jour. Parasitology,* 22: 512, 1936.

SCORPION STINGS

I HAVE read with much interest the contribution by H. L. Stahnke on "The Venomous Effects of Some Arizona Scorpions" in the issue of August 19. A brief account of personal experience may have interest.

About 20 years ago I was stung on the top of my right foot, just at the base of the little toe, at about 10 o'clock at night. A small red spot appeared and pain began promptly, increased in volume, and soon the entire foot seemed to ache. There was only slight swelling then or later. The pain gradually diminished during the following day.

The most pronounced effect was what appeared to be a nervous reaction. As I naturally am a heavy sleeper and was tired physically, I do not know what happened during the night. The next morning, however, the tips of my fingers, toes and ears and the point of my nose and my chin throbbed and twitched noticeably. There was a slight itching sensation and also somewhat the same feeling that a foot has after being "asleep."

The twitching was a definite muscular reaction, and the extremities actually moved spasmodically. This continued during the first day but gradually diminished during the course of the second day after the stinging.

After the attack, the scorpion retreated into a deep crevice in an unfinished portion of the room and could be seen but not captured. It appeared to be about 3½ inches long. This occurred at the Federal Plant Industry Field Station near San Antonio, Texas.

It should be noted that I am markedly resistant to some poisons. I am practically immune from poison ivy infection, very resistant to local anesthetics and

but little troubled by mosquitoes and fleas or flies. On the other hand, I am susceptible to nettle stings and very susceptible to "chigger" bites if preventive treatments are not employed. I have never been bitten by poisonous snakes, tarantulas or spiders, nor stung by bees or hornets, although prowling out of doors most of my life.

CARLETON R. BALL

EXTENSION SERVICE,
U. S. DEPARTMENT OF AGRICULTURE

QUOTATIONS

THE SCIENTIFIC MONTHLY AND THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

AT the April, 1925, meeting of the executive committee of the council of the American Association for the Advancement of Science, the editor and owner of SCIENCE offered under certain conditions to let the journal, which since 1900 had been the official organ of the association, become its absolute property. The plan was approved by the executive committee, which unanimously voted "its sincere and hearty thanks to Dr. Cattell for his most generous offer." The agreement was put in contractual form by Dr. Roscoe Pound, dean of the Harvard Law School, one of the distinguished fellows of the association, originally elected for his contributions to botany. The contract was executed by the owner of SCIENCE and Dr. Pupin, president of the association, and attested by Dr. Livingston, permanent secretary, on July 28, 1925. It was approved by a unanimous vote of the council of the association on December 30, and a committee, consisting of Drs. Pupin, Kellogg and Livingston, was appointed to express to Dr. Cattell the appreciative thanks of the association.

At the annual meeting of the association held in Atlantic City in December, 1936, a similar offer was made in regard to *The Scientific Monthly,* which has been an official journal of the association since 1907 to the extent that it may be received by members in place of SCIENCE. The offer was referred to a subcommittee consisting of Professor Edwin G. Conklin, president of the association; Professor George D. Birkhoff, president-elect, and Professor Burton E. Livingston, formerly permanent secretary. This committee reported to the executive committee meeting in New York in April, 1937, as follows:

> The subcommittee is unanimously agreed that Dr. Cattell's proposal is a very generous one and that it will be of much present value to the association and may in the future become of still greater value. We, therefore, recommend that it be adopted with hearty thanks and that the President and Permanent Secretary of the Association be authorized and directed to take such steps as may be necessary therefor and to enter into and to execute a contract for this transfer of *The Scientific Monthly* from its present owner to the American Association for the Advancement of Science, in conformity with the terms of the proposal of Dr. Cattell dated December 25, 1936, and that this action be reported to the council at the Denver meeting. We also wish to express to Dr. and Mrs. Cattell our sincere appreciation of their great and long-continued services to scientific organization, cooperation and progress.

This report was unanimously approved by the executive committee and was reported to the council at the Denver meeting. In view of this action it was decided last spring to let *The Scientific Monthly* be edited at the Washington office of the association, and Dr. F. R. Moulton, permanent secretary of the association, and the late Dr. Earl B. McKinley, member of the executive committee, agreed to join in the editorship, Ware Cattell remaining as associate editor. Manuscripts and other editorial communications should now be sent to The Editors of *The Scientific Monthly,* Smithsonian Institution Building, Washington, D. C.

The Scientific Monthly, then named *The Popular Science Monthly,* was established by J. W. Youmans and the firm of D. Appleton and Company in 1872. In its earlier years organic evolution and natural selection excited controversy and wide public interest; the journal attained much influence and a relatively large circulation. The Appletons published in the United States the works of many British men of science and were able to print in the *Monthly* articles by Darwin, Spencer, Huxley, Tyndall and other leaders. After the death of the elder Youmans and the development of more technical work in science the journal became unprofitable, having been conducted for a time at an annual loss of about $10,000. It was then sold to the present owner and editor.

The transfer of the journal to the American Association, combined with efficient editorship, should give the country a better journal of general science than it has ever before had. It should greatly increase the membership of the association and have the cooperation of all workers in science. There will be no change in editorial policy, but an endeavor will be made to make the journal not only authoritative, as it has always been, but of greater interest to those educated people who wish to follow the advances and share the spirit of science, the dominant factors in modern civilization.

The undertaking will be much more difficult without McKinley, who was admirably fitted for the editorship of a journal such as *The Scientific Monthly.* His loss with the ill-fated Hawaii Clipper, while collecting

germs in the upper air for his studies on the distribution of disease, was a disaster to science the magnitude of which can only be appreciated by those who have worked with him. He was dean of the Medical School of the George Washington University and was engaged in scientific work of originality and importance. In addition to these engagements he devoted a considerable part of his time and unlimited energy to scientific organization. In recent years he has taken a leading part in the work of the American Association for the Advancement of Science and for it his loss is irreparable. As one of the editors of *The Scientific Monthly* he would surely have had the usefulness and the success that attended all his enterprises. McKinley had genius for scientific research, organization and administration; most of all, for friendship. There is none like him, none, nor will be.

J. McK. C.

SOCIETIES AND MEETINGS

THE SEMICENTENNIAL CELEBRATION OF THE AMERICAN MATHEMATICAL SOCIETY

IN recognition of the fiftieth anniversary of its founding as the New York Mathematical Society, the American Mathematical Society arranged for its summer meeting this year not only a scientific program of unusual interest, but a jubilee celebration of significance. The meetings were held from September 6 to 9, at Columbia University.

Preceded by seven sectional meetings, at which over one hundred research papers were communicated, the scientific part of the anniversary observance consisted of ten invited addresses reviewing aspects of the development of mathematics during the past fifty years and pointing out some of the indications for progress in the future. The speakers and their topics were as follows:

R. C. Archibald, Brown University, "History of the American Mathematical Society, 1888–1938."

G. D. Birkhoff, Harvard University, "Fifty Years of American Mathematics."

E. T. Bell, California Institute of Technology, "Fifty Years of Algebra in America, 1888–1938."

G. C. Evans, University of California, "Dirichlet Problems."

E. J. McShane, University of Virginia, "Recent Developments in the Calculus of Variations."

J. F. Ritt, Columbia University, "Algebraic Aspects of the Theory of Differential Equations."

J. L. Synge, University of Toronto, "Hydrodynamical Stability."

T. Y. Thomas, University of California at Los Angeles, "Recent Trends in Geometry." (Read by Mr. J. F. Daly, of Princeton University.)

Norbert Wiener, Massachusetts Institute of Technology, "The Historical Background of Harmonic Analysis."

R. L. Wilder, University of Michigan, "The Sphere in Topology."

These addresses, except that by Professor Archibald, have been published by the society under the title of "Semicentennial Addresses," as Volume II of its Semicentennial Publications. Volume I is a history of the society written by Professor Archibald and containing in greatly amplified form the material of his lecture. The fact that these volumes were in print and ready for distribution at the time of the meeting added not a little to the import of the addresses as part of an anniversary celebration.

Several scientific exhibits dealing with the history, teaching and applications of mathematics were arranged by Columbia University and members of its faculty; these also added greatly to the celebration.

The features of the meeting more closely related to the jubilee were introduced by a reception tendered by Columbia University to the visiting mathematicians, who were received by President and Mrs. Nicholas Murray Butler. Immediately following the reception, a convocation of the society was held, at which delegates from sister organizations were introduced, and letters of greeting and felicitation presented. This gathering also afforded an occasion for the society to voice its gratitude to Columbia University for its hospitality and patronage during the half-century, for the American Mathematical Society was founded at Columbia, by Columbia men; over half of its regular meetings have been in Columbia halls; and its office and library have been housed in Columbia buildings. Professor Rudolph E. Langer, of the University of Wisconsin, vice-president of the society, delivered a brief address of appreciation on behalf of the society for what it had received from Columbia (in the words of Professor Langer) "the worthiest and sublimest of gifts . . . a portion of herself." Following this, Professor Langer presented to President Butler a copy of the address, beautifully printed on French hand-made paper, and a copy of each of the two volumes of the Semicentennial Publications, specially bound in brown pigskin and bearing a suitable dedicatory inscription. President Butler responded in a noteworthy address.

The most outstanding feature of the celebration, however, was surely the "Birthday Dinner," at which the society delighted to honor its founder, Professor Thomas Scott Fiske, of Columbia University. It must indeed be almost unique in the annals of scientific organizations for a society to be able to honor its

founder in person at its jubilee. To him was presented an illuminated testimonial containing a greeting of appreciation and affection, prepared by order of the society and signed by the president and secretary. There was presented to Miss Natalie P. Fiske, daughter of Professor Fiske, and to the society bronze replicas of a sculptured bas-relief portrait of Professor Fiske, done by the young Philadelphia sculptor, Mr. George John Sklaar, of the faculty of the New Jersey College for Women. A group of mathematicians who had been associated with Professor Fiske in the work of the College Entrance Examination Board presented to the society a portrait of Professor Fiske painted by Mrs. H. E. Ogden Campbell. Professor Fiske spoke in reminiscent vein of interesting events in the early days of the organization.

As a fitting climax to this central event of the celebration, letters addressed to Professor R. G. D. Richardson, secretary of the society, were read from President Franklin D. Roosevelt and Prime Minister W. L. Mackenzie King, of the Dominion of Canada, for the American Mathematical Society extends north of the border. The emphasis reflected in these letters may well be gratifying to all scientists. They are as follows:

From President Franklin D. Roosevelt:

Please extend my greetings to the American Mathematical Society on the occasion of the celebration of its fiftieth anniversary. I trust that genuine satisfaction will come to its members as they contemplate the contribution which the Society has made during the half century of its existence.

It is sometimes difficult to comprehend the values accruing to society from mathematics. It is deeply rooted in social progress as a large part of the technological advance made in recent centuries would have been impossible had it not been for the constant refinement of the essential tool of technology—mathematics. Social sciences also owe a large debt to mathematics. Future advances in the social sciences will be largely dependent upon mathematical treatment of their data.

I congratulate the members of the American Mathematical Society on the important contributions which mathematics has already made. I trust that the years ahead will find mathematicians making significant contributions, as in the past.

From Prime Minister W. L. Mackenzie King:

I shall be pleased if you will extend to the American Mathematical Society, on the celebration of the fiftieth anniversary of its inception, my greetings and warm congratulations upon attaining this significant anniversary.

It is well that we should reflect, on occasions such as this, on the extent to which the learned societies of this continent have contributed to the strength and substance of our national and international life. The work of the American Mathematical Society fills a distinguished place among those academic fellowships which have done so much to keep alive, in our institutions of learning, that integrity of thought which is one of the proudest of our common traditions.

It is my hope that the deliberations of the Society's Jubilee Meeting will be attended by much good fellowship and a lively appreciation of the binding character of the academic fraternity which has so long and so happily prevailed between our two countries.

ALBERT E. MEDER, JR.
NEW JERSEY COLLEGE FOR WOMEN,
NEW BRUNSWICK, N. J.

SPECIAL ARTICLES

REPULSIVE FORCES BETWEEN CHARGED SURFACES IN WATER, AND THE CAUSE OF THE JONES-RAY EFFECT

CONSIDER a plane surface of potential V which bounds a semi-infinite volume of a dilute salt solution of potential 0. Taking the salt to be of the univalent type, such as KCl and applying the Poisson and Boltzmann equations, the potential distribution must satisfy the equation

$$\frac{d^2V}{dx^2} = 4\pi n_0 (e/D)\,[\exp(Ve/kT) - \exp(-Ve/kT)], \qquad (1)$$

where n_0 is the number of ions (of each sign) per unit volume in the solution in regions where $V = 0$.

Let us put

$$\eta = Ve/kT \qquad (2)$$

and

$$\theta = x/\lambda \qquad (3)$$

where λ, the value of $1/\kappa$ in the Debye-Hückel theory, is given by

$$\lambda^2 = DkT/8\pi e^2 n_0 \qquad (4)$$

Eq. (1) then becomes

$$2d^2\eta/d\theta^2 = \varepsilon^{\eta} - \varepsilon^{-\eta} \qquad (5)$$

In the Debye-Hückel theory it is assumed that η is so small that ε^{η} can be replaced by $1+\eta$. We wish, however, to apply Eq. (5) to two parallel plates which are separated by the distance b but are so close together and are so highly positively charged that $\eta >> 1$, everywhere between the plates. The Debye-Hückel approximation therefore can not be used, but instead, we can neglect $\varepsilon^{-\eta}$ in Eq. (5), since it is small compared to ε^{η}.

Integration gives

$$\theta = 2\exp(-\eta_M/2)\,\tan^{-1}[\exp(\eta - \eta_M) - 1]^{1/2} \qquad (6)$$

where η_M is the minimum value of η which occurs at the plane half way between the plates and θ measures the distance from this median plane. If η_1 and θ_1 are the values of η and θ at the surface of the plates and

we take the case that the plates are so highly charged that $\eta_1 >> \eta_M$ then Eq. (6) becomes

$$\theta_1 = \pi \exp(-\eta_M/2) - 2\exp(-\eta_1/2) \qquad (7)$$

where the term containing η_1 is very small compared to that which contains η_M.

Repulsive Forces Between Plates: The plates are acted upon by forces of two kinds: A pressure nkT due to the negative ions and a negative pressure or pull due to electric field E; the sum of the two must be constant for all values of θ in the space between the plates. At the median plane we see from the symmetry that $E = 0$ and therefore the force acting per unit area on the plates is the pressure $p = n_M kT$ where n_M is the concentration of negative ions at the median plane.

The value of n_M can be calculated from η_M by the Boltzmann equation. To obtain the net pressure between the plates we should subtract the pressure $2n_0kT$ which acts on the other side of each plate, giving

$$p = n_0 kT(\exp \eta_M - 2) \qquad (8)$$

Since, however, we are taking at present only the case where $\eta_1 >> \eta_M >> 1$ we can neglect the 2 in the parenthesis in Eq. (8) and the last term of Eq. (7) and so from Eqs. (7), (8) and (3), placing $x_1 = b/2$, we obtain

$$p = n_0 kT(2\pi\lambda/b)^2 \qquad (9)$$

We can now eliminate λ by Eq. (4):

$$p = (\pi/2)D(kT/eb)^2 \qquad (10)$$

This gives the repulsive force between two planes with high charges of similar sign when they are separated by a distance which is small compared to 2λ. It is interesting to note that this limiting expression does not contain the potential of the plates, the concentration of the electrolyte or any other adjustable parameter. The force varies inversely as the square of the distance between the plates. To determine its numerical magnitude let us place $D = 81$ (the dielectric constant of water at 20° C), $T = 293°$ K and so obtain

$$p = 8.90 \times 10^{-7}/b^2 \text{ dynes/cm}^2 \qquad (11)$$

Thus, when the surfaces are at a distance of 10^{-4} cm (1μ) the repulsive force is 89 dynes cm^{-2}.

This repulsive force, which involves no new mechanism, together with attractive Coulomb forces, is found to be of just the right magnitude to account for the formation of tactoids and unipolar coacervates (which involve the spontaneous separation of certain colloidal solutions into two liquid phases).[1]

Repulsion Between a Plate and an Air-Water Interface: The same pressure p, which acts according to Eq. (10) between two plates separated by the distance b, should also act between a single plate and an air-water interface at a distance $b/2$, for in both cases at a distance $b/2$ from the plate the boundary condition $d\eta/d\theta = 0$ is fulfilled. If then a highly charged (ζ-potential) plate held vertically is partly raised out of a dilute water solution of an electrolyte, the water should drain off until a limiting thickness t is reached, where t will vary with the height h above the water surface. In the liquid of the film when equilibrium has been reached there will be a pressure

$$p = -\rho gh \qquad (12)$$

if the pressure at the free horizontal surface is zero. Here ρ is the density and g the acceleration of gravity.

The surface of the water film is acted on by this negative pressure and by the positive outward pressure p given by Eq. (10), and these two forces must be equal. Eliminating p between Eqs. (10) and (12), we find that the film thickness is

$$t = (kT/e)(\pi D/8\rho gh)^{1/2} = 1.52 \times 10^{-5}/h^{1/2} \text{ cm} \qquad (13)$$

if we take $D = 81$, $T = 293°$ K, $\rho = 1$, $g = 980$. Thus at a height of 10 cm above the horizontal water surface the film of water should have a thickness of 480 Å.

Experiments are under way to measure the thickness of such films on barium stearate multilayers of critical thickness, which have been made hydrophilic by conditioning in thorium nitrate and sodium silicate. Because of the negative pressure in the water in these films, the vapor pressure of the water must be lowered, but calculation shows that an elevation of temperature of only 0.001° C would decrease t from 480 Å to 165 Å. To obtain data for a quantitative test of Eq. (13) it will be necessary to have good temperature control.

Water Films on the Walls of Capillaries: In a capillary tube of radius r in presence of saturated water vapor, there will also be a water film.

Because of the curvature (one half that of a sphere of equal radius) the surface tension γ exerts a force or pressure γ/r on the surface of the film that acts in the same direction as that given by Eq. (10). Thus in place of Eq. (13) we have

$$\Delta r = (kT/e)[\pi D/8(\rho gh - \gamma/r)]^{1/2} \qquad (14)$$

Surface Tensions of Dilute Salt Solutions: Jones and Ray,[2] by developing an extremely accurate differential method for measuring relative surface tensions, have found an extraordinary effect by which very low concentrations of salts appear to *decrease* the surface tension of water. The effect occurs only at molar concentrations (of KCl) below about 8×10^{-4} and the maximum decrease amounts to about 0.015 dyne cm^{-1}.

The theory outlined above which led to Eq. (14) seems to offer a simple explanation of the Jones-Ray effect. A water film on the wall of the capillary has the effect of decreasing the effective radius so that the solution rises to a greater height than if such a

[1] A paper soon to appear in the *Journal of Chemical Physics.*

[2] Grinnell Jones and W. A. Ray, *Jour. Am. Chem. Soc.*, 59: 187, 1937.

film were not present. The film disappears at higher salt concentrations because the charge (ζ-potential) becomes less (or λ becomes comparable to Δr), and thus the capillary rise h_s decreases and produces an apparent decrease in surface tension.

If we measure the capillary rise in a tube of radius r whose walls are covered by a water film of thickness Δr the surface tension of the water should be calculated by

$$\gamma = \tfrac{1}{2}\rho g h (r - \Delta r). \qquad (15)$$

Jones and Ray, however, calculated their surface tension by the equation

$$\gamma_{JR} = \tfrac{1}{2}\rho g h r. \qquad (16)$$

The value of Δr can be calculated by Eq. (14) by inserting $\gamma/r = \rho g h/2$, so that we have

$$\Delta r = (kT/2e)\,(\pi D/\rho g h)^{1/2} = 2.16 \times 10^{-5}/h^{1/2} \qquad (17)$$

According to this interpretation the values of γ_{JR} at low concentrations are higher than the true surface tension of water by an amount:

$$\gamma_{JR} - \gamma = (kT/4e)\,(\pi D \rho g h)^{1/2} = 0.0107 h^{1/2} \qquad (18)$$

Jones and Ray in all their experiments used a single capillary of radius $r = 0.01361$ cm, and the capillary rise was $h = 10.8$ cm. According to Eq. (18) the increment $\gamma_{JR} - \gamma$ should have been 0.035 dyne cm^{-1}. This is of the same order of magnitude as the apparent decrease in surface tension of 0.015 dyne cm^{-1} which they observed at concentrations below 10^{-3} M.

The values of Δr and $\Delta\gamma$ given by Eqs. (17) and (18) have been based on the assumptions that $\Delta r << \lambda$ and $\eta_1 >> \eta_M >> 1$. When these conditions are not fulfilled, Δr and $\Delta\gamma$ will have lower values.

In the following table the values of λ are given for various assumed concentrations between 10^{-3} and 10^{-5} M as calculated from Eq. (4). The next column contains values of $\Delta\gamma$ from a curve plotted from data of Jones and Ray for KCl. From these we can calculate values of Δr which would account for these values of $\Delta\gamma$. The last column gives η_M as calculated from Eq. (8) by inserting $p = \rho g h/2 = 5300$ dynes cm^{-2}. The values of λ decrease far below the maximum value of Δr (280 Å), but Δr decreases too, so that in all cases the condition $\Delta r << \lambda$ is approximately fulfilled. The reason that Δr never rises as high as 650 Å, which is given by Eq. (17), is that the condition $\eta_1 >> \eta_M$ is not fulfilled at the lowest concentrations.

TABLE I

CALCULATIONS BASED ON THE SURFACE TENSION DATA OF JONES AND RAY FOR KCl

Molar concentration	λ	$\gamma_{JR} - \gamma$ dyne cm^{-1}	Δr obs	η_M
0.0010	97 Å	0.000	..	0.46
.0005	137	.0014	26 Å	0.65
.0003	178	.0065	122	0.82
.0002	217	.009	174	1.01
.0001	307	.012	230	1.36
10^{-5}	970	.015	280	3.15

The ζ-potentials determined by the electric mobility of particles of glass and quartz[3] are negative and are of the order of 50 to 100 millivolts at concentrations of about 10^{-5} to 10^{-6} M and decrease rapidly as the concentration rises from 10^{-4} to 10^{-3} M. The highest values of η_1 calculated by Eq. (2) from these potentials thus range from 2 to 4. The marked decrease in η_M to low values shown in Table I as the concentration increases is probably the cause of the decreases in Δr and $\Delta\gamma$ at higher concentrations.

These rough calculations show that the Jones-Ray effect can be adequately explained on the basis of a water film held on the surface of the capillary tube by electric charges bound by the quartz.

The present paper is merely preliminary. It has been possible to obtain a complete integration of Eq. (5) in terms of elliptic functions. Some calculations have shown that by applying these exact expressions to the experimental data of Jones and Ray it is possible to calculate the potential of the quartz surface at each concentration. These potentials are reasonable and vary with the concentration in the manner shown by mobility experiments.

Further experiments should make it possible to check this suggested theory. For example, we see by Eq. (18) that $\Delta\gamma$, which does not represent a true change in surface tension, should vary in proportion to $h^{1/2}$ or $r^{-1/2}$. The addition of thorium nitrate in concentration of 10^{-6} M brings the ζ-potential of glass to about zero.[3] This should eliminate the Jones-Ray effect. If solutions of proteins are passed through the capillary and this is then carefully washed, the ζ-potential can be made to vary through wide ranges, depending on the choice of protein, and the pH of the solution. This should cause marked variations in the Jones-Ray effect.

IRVING LANGMUIR

GENERAL ELECTRIC COMPANY,
SCHENECTADY, N. Y.

THE EFFECTS OF AGE AND ESTROGEN ON THE STROMA OF VAGINA, CERVIX AND UTERUS IN THE MOUSE[1]

UNDER normal conditions an increase in the amount of collagen in the stroma of vagina, cervix and uterus of mice begins in the first few weeks of life and from then on progresses more definitely in older mice, especially after cessation of the sexually active period. However, on the whole the differences found at different age periods are relatively not great as compared with those experimentally produced through the ad-

[3] H. A. Abramson, "Electrokinetic Phenomena," Chemical Catalog Company, New York, 1934. See pp. 203–8.

[1] These investigations were carried out with the aid of grants from the International Cancer Research Foundation and from the Committee on Research in Endocrinology of the National Research Council.

ministration of estrogen. Injections of estrogen extending over long periods increases the amount of fibrous-hyaline material which is deposited in the stroma; this increase is the greater, the larger the amounts of estrogen injected at each period and the longer it is continued. If very large doses of estrogen (100 or more rat units in oil) are injected weekly, large amounts of a hyaline substance are deposited, which act as foreign bodies and cause the formation of epithelioid and giant cells and an ingrowth of connective tissue. Thus an organization of this substance is attempted, which is interrupted, however, by renewed deposition of this hyaline material. In certain places solution processes seem to be associated with the hyalinization of the connective tissue and non-striated muscle layers. No definite statement can be made at present as to the chemical nature of this substance and its possible relation to a plasma constituent, except that it is not amyloid.

A hormone, estrogen, may affect therefore the stroma of various organs in two opposite directions: By inducing growth processes in the epithelial structures and perhaps also by definite changes in the circulation it may cause an activation of the stroma and a diminution in the amount of fibrous-hyaline material in various tissues; this seems to occur also in uterus and vagina under certain conditions. But if very large doses of this hormone are administered over long periods of time, the opposite effect may be obtained, namely, a very intense fibrosis and hyalinization of the stroma which may induce abnormal reactions in the surrounding tissue. In this way it seems to be possible to accelerate and intensify very much some of the old age changes in certain organs.

LEO LOEB
V. SUNTZEFF
E. L. BURNS

LABORATORY OF RESEARCH PATHOLOGY,
OSCAR JOHNSON INSTITUTE,
WASHINGTON UNIVERSITY
SCHOOL OF MEDICINE,
ST. LOUIS

THE EFFECTS OF AGE AND HORMONES ON THE STROMA OF THYROID AND MAMMARY GLAND IN THE GUINEA PIG[1]

IT is assumed that one of the changes characteristic of old age in higher organisms consists in an increase and condensation of the collagen in the stroma of various organs and that such changes may reduce the metabolic activities of sensitive tissues. We have begun, therefore, a study of the changes which take place in the stroma at different age periods, as well as of the effect of various hormones on this tissue.

(1) In the thyroid gland of guinea pigs at about the time of birth the amount and density of the stroma are relatively slight. From then on a constant increase in the amount of fibrous tissue takes place, especially around the arteries, but less about the veins and least around the lymph vessels. This increase is already considerable in young, sexually immature female guinea pigs weighing about 180 grams; it increases still more in older guinea pigs, although in individual cases certain variations occur in this respect. Growth and functional stimulation of the thyroid gland by the stimulating hormone of the anterior pituitary gland causes a partial loosening of the stroma, owing to increased transudation from the blood vessels. However this does not, as a rule, cause a noticeable loosening of the dense fibrous tissue directly surrounding the arteries.

(2) In the mammary gland and in the surrounding fat tissue changes occur similar to those observed in the thyroid gland of young and adult guinea pigs; but here much dense fibrous tissue develops, not only around the blood vessels, but also around the larger ducts. There is less fibrous tissue around the end ducts and acini, which function and grow actively; however, a complete parallelism between the amount and density of the stroma in thyroid and mammary gland does not exist because of the differences in functional and growth changes and other more accidental factors in these organs.

In the mammary gland a transformation of the dense fibrous-hyaline into loose fibroblastic, fibrillar stroma can be readily accomplished under the influence of hormones which stimulate the growth of the mammary gland tissue. Implantations of pieces of cattle anterior pituitary gland previously treated with formalin or with urea and glycerin are very efficient for this purpose; they cause maturation of ovarian follicles and the discharge of oestrogen into the circulation. Accompanying the growth processes in the epithelium of the mammary gland a marked stimulation of the surrounding stroma occurs, leading to mitotic proliferation and amoeboid movement of fibroblasts. They readily change the dense fibrous tissue around the ducts into a loose and much more permeable fibrillar, cellular stroma. These effects begin around the glandular structures, but they may extend from there with gradually diminishing intensity also to the adjoining fibrous-hyaline material around arteries and to the fibrous-hyaline bands in the fat tissue. This condition suggests the action of hormone-like contact substances which are given off by the active gland structures and which then diffuse for a certain distance into the neighboring stroma. Such a conception would agree with our earlier conclusion that contact substances might be responsible for growth and move-

[1] These investigations were carried out with the aid of grants from the International Cancer Research Foundation and from the Committee on Research in Endocrinology of the National Research Council.

ments of previously resting cells surrounding active cells or tissues. While in the mammary gland hormones in all probability affect the stroma only indirectly by way of the glandular structures, a hormone given off by the corpus luteum is able to exert a direct growth-stimulating effect on the uterine stroma.

We may then conclude that an increase in amount and density of stroma elements in certain organs begins very early in life and progresses steadily from then on, and that hormones may counteract this effect by loosening the stroma in three different ways, namely: (1) by their effect on the circulation; (2) by their stimulating action on epithelial parenchyma and (3) by a direct effect on the stroma. These observations suggest that the fibrosis and hyalinization of the stroma which occurs with advancing age may perhaps be reversible under the influence of hormones, at least in certain instances.

LEO LOEB
R. M. SIMPSON
LABORATORY OF RESEARCH PATHOLOGY,
OSCAR JOHNSON INSTITUTE,
WASHINGTON UNIVERSITY
SCHOOL OF MEDICINE,
ST. LOUIS

AN ADRENALINE-LIKE SUBSTANCE IN POSTGANGLIONIC SYMPATHETIC FIBERS

BY using bicarbonate-free Ringer's solution containing physostigmine (1:50,000) extracts were made from different nerves of the cat, dog, rabbit and frog. The extracts were dialyzed against physostigmine-Ringer's solution by the method of Loewi.[1] After four hours the dialysate was tested on isolated hearts of frogs, according to the method of Straub. Control experiments were made with the other acetylcholine extraction methods (acid alcohol, trichloracetic acid and heating) and were tested on the frog heart, rectus abdominis of the frog and the back muscle of the leech.

Extracts of various nerves (vagus and sympathetic of the neck, sciatic, phrenic, optic, thoracic sympathetic chain and superior cervical ganglion) contain different amounts of acetylcholine.

Preganglionically denervated superior cervical ganglia (with the postganglionic fibers) of the cat and rabbit, one to two weeks after operation, no longer contain acetylcholine, but an adrenaline-like substance having positive inotropic and chronotropic effects on the frog heart. In cats and dogs the ventral esophageal branches of the vagi were cut below the diaphragm. After two weeks the postganglionic sympathetic fibers along the superior mesenteric artery were extracted and were found to contain no acetylcholine but an adrenaline-like substance.

[1] O. Loewi, *Pflüger's Arch.*, 227: 504, 1936.

If extracts of mixed nerves were made with bicarbonate-free Ringer's solution without physostigmine, acetylcholine was totally eliminated and only the adrenaline-like substance was present.

These experiments showed that from all the nerves examined which contain postganglionic sympathetic fibers an adrenaline-like substance can be extracted. The vagus fibers of the dog, but not of the cat, contain this substance. Evidence of its presence was found in extracts from the cervical sympathetic ganglia and their fibers, from the sciatic, from the superior mesenteric plexus and ganglion, but not from the phrenic nerve.

This adrenaline-like substance passes easily through a dialysis membrane (Cellophane), is oxidizable and is destroyed by ashing or simple heating to near the boiling point for a few minutes. It has positive inotropic and chronotropic effects on a hypodynamic frog heart, which are abolished by ergotoxine. The substance has a positive action on the blood pressure of the cat (adrenals ligated). The substance has properties similar to sympathin and adrenaline. On the assumption that it is sympathin the highest content was found in the superior mesenteric plexus of the cat (about 4 to 6 γ per gram of nerve). The amount from the superior mesenteric plexus of one cat is enough to cause, when intravenously injected, a rise of 20 mm Hg. in the blood pressure of another cat. This action on the cat's blood pressure provides the possibility of studying the properties of sympathin more completely in further experiments.

K. LISSÁK,
Fellow of the Rockefeller Foundation
DEPARTMENT OF PHYSIOLOGY,
HARVARD MEDICAL SCHOOL

BOOKS RECEIVED

Catalogue des Manuscrits Éthiopiens de la Collection Griaule, Première Partie, Sections I–VI; Travaus et Memoires de L'Institut D'Ethnologie, XXIX. Pp. ix + 320. 8 plates. Institut D'Ethnologie, University of Paris. 125 fr.

The Collected Works of George Abram Miller; Vol. II. Pp. xi + 537. University of Illinois. $7.50.

HOFFMANN, RALPH. *Birds of the Pacific States.* Pp. xix + 353. Illustrated. Houghton Mifflin. $3.50.

ROBERTS, W. R. WESTROPP. *Elliptic and Hyperelliptic Integrals and Allied Theory.* Pp. viii + 311. Cambridge University Press, Macmillan. $3.75.

ROJANSKY, VLADIMIR. *Introductory Quantum Mechanics.* Pp. x + 544. Prentice-Hall. $5.50.

The Snellius-Expedition in the Eastern Part of the Netherlands East-Indies, 1929–1930, under the Leadership of P. M. Van Riel; Vol. I, Voyage. Pp. viii + 177. Illustrated. 20 guilders. *Vol. II, Part 4, Oceanographic Results; Surface-Observations, Temperature, Salinity, Density; by Dr. S. W. Visser.* Pp. 62. 5 guilders. E. J. Brill, Leiden, Holland.

STRONG, JOHN and others. *Procedures in Experimental Physics.* Pp. x + 642. Illustrated. Prentice-Hall. $5.00.